AB INITIO LARGE-BASIS NO-CORE SHELL MODEL

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The large-basis no-core shell-model (NCSM) approach allows one to perform *ab initio* calculations of the properties of nuclei up to mass $A = 16$. This technique is based on a separation between the model space and the excluded space at either the two-body or three-body cluster level[1,2]. Results converged to very high accuracy have been obtained with this procedure for the $A = 3$ and $A = 4$ systems. For the $A = 3$ system we have also performed calculations including a two-pion-exchange three-nucleon (NNN) interaction. Recently calculations have been performed at the three-body cluster level for p-shell nuclei, with and without a NNN interaction. In the former case, we can investigate the influence of NNN forces on nuclear properties as well as study how various models for the NNN interaction differ in their description of nuclear structure. In the latter case, we are able to look at how convergence properties of our NCSM calculations are improved by increasing the cluster level. Application of our *ab initio* NCSM approach to p-shell nuclei has allowed us to study, for example, the soft-dipole mode in ^{6}He and the properties of exotic nuclei, as well as to obtain a good approximation to the low-lying properties for the nuclei investigated[3]. Work is in progress to expand the model spaces and obtain even greater convergence as well as on exact calculations of other effective operators. Because we are able to exactly determine the structure of the effective interactions and operators employed in our investigations of these lighter nuclei, we hope to gain insight into how to extrapolate this knowledge to construct similar interactions and operators for heavier nuclei.

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